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ON A COLACODASYA FROM SOUTHERN CALIFORNIA

BY

MABEL EFFIE McFADDEN

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ON A COLACODASYA FROM SOUTHERN CALIFORNIA*

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Attention was first called to the matter of parasitic Florideae by Reinsch in 1874 (*Contrib. ad Algol. et Fungol*). Here the first descriptions of several forms are given. In addition, several structures were described as parasites which, on further study, have proved to be quite different. Among these structures are warts and holdfasts, now recognized as essential parts of the plant on which they occur. Interest was aroused by this beginning and the work has been gradually extended.

The work on the parasitic Florideae of California was begun by C. P. Nott. In 1897, he published (*Erythea,* vol. V, p. 81-84) notes on "Some Parasitic Florideae of the California Coast." He enumerates three species, *Sterrocolax decipiens* Schmitz, on *Ahnfeldtia plicata* (Hudson) Fries, *Gonimophyllum Buffhami* Batters on *Nitophyllum Ruprechtianum* J. Ag., and *Janczewskia verrucaeformis* Solms on *Laurencia pinnatifidia* Lam'x and on *Agardhiella tenera* (J. Ag.) Schmitz (*Rhabdonia Coulteri.* Harv.). In 1896 Professor A. J. McClatchie found a species of Harveyella, *H. mirabilis* Schmitz (now *Gracilariophila oryzoides* Setchell and Wilson, *Univ. Calif. Publ. Botany,* vol. 4, p. 81, 1910) growing on *Gracilaria multipartita* (Clem) Harv., and

* A thesis submitted in partial satisfaction of the requirements for the degree of Master of Science, at the University of California, Berkeley, California, May, 1910.

also a species of Actinococcus on *Gymnogongrus linearis* (Turn.) J. Ag.

In 1905, Professor W. A. Setchell published (*Nuova Notarisia,* April, 1905) notes on "Parasitic Florideae of California." In addition to the species already mentioned, he adds *Ceramium codicola* J. Ag. on *Codium mucronatum* var. *californicum, Ricardia Montagnei* var. *gigantea* Farlow on *Laurencia virgata* J. Ag. and *Peyssonneliopsis epiphytica* Setchell and Lawson on a species of Callymenia.

Mention is also made (*loc. cit.*) of a few specimens of a parasitic red alga, growing on *Mychodea episcopalis* J. Ag. "This parasite was first detected by Professor W. G. Farlow, who thinks that it represents the type of a new genus, but further supplies of material are awaited." Later a large amount of material was found at San Pedro, California, by Dr. N. L. Gardner, in exactly the same locality and on the same host, and the material was given to me for study.

The host, *Mychodea episcopalis* J. Ag., was first described by J. G. Agardh (1884, p. 82) and later by De Toni (1897, p. 282). Specimens were distributed in Phyc. Bor. Amer. No. 1497, having been collected by Miss S. P. Monks at San Pedro, California, in 1907. Its identity is indicated by the following note: "This seems to agree with the type specimens in Herb. J. Ag." (*loc. cit.*).

The Mychodea has a simple, branched frond. The branches are lateral, and are characterized by being suddenly attenuated at the base, where they are attached to the main frond. The tip of the main frond is often conspicuously coiled, and the tips of the lateral branches are also sometimes coiled. The frond is made up of a central axis, surrounded by two to four layers of cells, forming the cortex. Adventitious holdfasts are developed at intervals along the fronds. No fruiting bodies have yet been found.

The parasite appears as little nodules along the thread of the Mychodea. These have very little pigment, so appear as white dots, about 0.5–1.5 mm. in diameter, on the surface of the Mychodea. The host is often slightly bent at the point where the

parasite appears, showing that there is a disturbance in the growth of the host at that point.

A more careful study of this relationship shows that the parasite, which probably enters from the outside and breaks through between the cells of the host, immediately grows inward between the cells of the cortex of the host to the central axis. This penetration is brought about by multicellular rhizoidal branches, which force themselves in between the cells of the host. After this first simple penetration, which does not greatly affect the arrangement of the cells of the host, these rhizoidal branches spread out, forming a compact central body, within the host. This gradually enlarges and sends out branches down along the central canal. The growth of this central mass of the parasite, forming, as it does, a wedge among the cells of the host, forces them farther and farther apart (see plate 19, fig. 1). Often the rhizoidal branches of the parasite completely encircle the central axis, pushing out in both directions from the starting point.

While this is going on, a wart of similar cells has developed at the surface (see plate 19, fig. 1). This is often a much larger mass of tissue than that which forms within the Mychodea filament. In both cases this tissue is composed of large, irregular-shaped cells, with rather thin walls. The contents of the cells in the specimens examined were shrunken, due to the action of the formalin solution in which they were placed. But, in spite of this shrinkage, a difference could be noted, in almost every case, between the cells of the parasite and the cells of the host. The cell contents of the former take the stains used in a slightly different way and appear more granular. The cell-walls of the parasite are almost transparent, having stained very slightly, while the walls of the host stain quite deeply.

From the wart of tissue growing outside of the Mychodea filament, branches arise which bear the organs of fructification. The wart forms the central half of the tuft, and the branches radiating from it form the other half. All three kinds of organs, antheridia, cystocarps, and tetrasporangia, are found, and each is borne on a different plant, that is, all the branches arising from a given wart bear the same kind of reproductive organs.

The structure of the branches of the parasite is of the Polysiphonial type. There is a large central axis with a single circle of seven or eight pericentral cells about it (see plate 19, fig. 3). There are two transverse partitions formed in each pericentral cell, so that there are three cells formed from each. It was quite difficult to determine the method of branching. But after careful study of the growing tips of the branches, I was able to find some instances (see plate 19, fig. 2) which correspond almost exactly with the figures by Falkenberg (1901, plate 8, fig. 18) and so determine that the branching is sympodial.

In addition to the large branches bearing the reproductive organs, there are other smaller branches growing from the wart. These are quite simple in structure, being one cell wide at the tip, but often two or three cells broad at the base, and measuring about 61 μ in length and 22 μ in breadth.

These branches may possibly be hairs, or they may be aborted branches. They are evidently different in structure from the larger fertile branches, but their exact nature is still doubtful.

The stichidia are borne laterally on branches arising from the wart. They are lance-shaped with a peculiar curved, or hooked tip. This curved portion is several cells in length, but only one cell broad (see plate 19, fig. 4). The tetraspores are borne in the middle or basal portions of the stichidium. The tetraspores are quite large and tripartite. Falkenberg (*loc. cit.*, p. 659) makes the following statement concerning the stichidia of *Colacodasya inconspicua:* "Gewöhnlich geht demgemäss das fertile Sympodium in zwei auseinanderspreizende Stichidien aus." I find that the stichidia in our plant are not always branched, and when branching occurs, it may be double or occasionally triple. Each of these branches show the characteristic curved tip.

The antheridia are borne on similar branches, but on different plants, as has already been stated. The antheridial branch is smaller than a stichidium, more cylindrical and blunt at the apex. The antherozoids are minute and crowded closely together at the surface of the antheridium, having the typical Polysiphonial form (Reinsch, 1890. Taf. XIII, figs. 2 and 3).

The cystocarps are born laterally on branches from the wart.

The fully developed cystocarp is an urceolate body, with a distinct carpostome at the top. The wall of the cystocarp is made up of a layer of small cells. From the base of the interior of the cystocarp, numerous ooblastema filaments arise, at the end of which the spores are formed. Falkenberg states that these filaments have monopodial branching (Falkenberg, 1901, p. 659). I have been unable to verify this satisfactorily, but such evidence as I have tends towards the same opinion. The spores are pear-shaped, numerous, 16 μ long, and borne singly, i.e., this is a typical Rhodomelaceous cystocarp.

The procarp arises from a small lateral branch near the tip of the frond; on this branch is borne a large auxillary cell, with several other cells associated with it. A more careful study of the younger stages would probably show a trichogyne, but I have not yet found one. The ooblastema filaments are developed with the spores at their tips, and around this the pericarp is formed. The pericarp arises as is normal for the family of the Rhodomelaceae and consists of a single layer of small cells. A broad carpostome is situated at the apex of the pericarp.

From the fact that the cystocarp is of the typical Rhodomelaceous type, this parasite is to be placed in the family of the Rhodomelaceae. From the fact that the branching is sympodial and not monopodial, we know that the parasite belongs to the sub-family Dasyeae. Of this sub-family, only one genus, Colacodasya, is described as parasitic. We, therefore, turn our attention to this genus.

The type species, *Colacodasya inconspicua,* was described and figured by Reinsch (1890, pp. 369-372; Taf. XII, Figs. 1-7; Taf. XIII, Figs. 1-5) under the name of *Merenia inconspicua* parasitic on *Merenia microcladioides* and on *Polysiphonia anisogona* and found in the South Georgian Sea. Schmitz, after examination of the original material, created for this species a new genus, calling it *Colacodasya inconspicua.* Falkenberg also examined the original preparation and verified the description given by Reinsch and added figures (1901, pp. 658-660; Taf. XVIII, Figs. 18 and 19). From these descriptions my knowledge of the type-species was obtained.

The specimens which I have examined agree with the descriptions in the following ways: (1) The plant is a small parasite. (2) All three kinds of fruiting bodies were found, each growing on a separate plant. (3) The structure of the cystocarp corresponds to the description. (4) The number of pericentral cells is about the same.

But the specimens which I have studied differ from the descriptions in several ways. (1) In the matter of geographical location, the type-species was found in the South Georgian Sea, while the material which I studied was found at San Pedro, California. (2) The host plant, instead of being either of those mentioned by Reinsch, is *Mychodea episcopalis* J. Ag. (3) From the drawing given by Reinsch (1890, Taf. XII, 5) one might conclude that the cells of the parasite were very much smaller, and able to penetrate between the cell-walls of the host without causing much disturbance of cell arrangement. In the specimens which I have examined, the case is quite different, as has already been stated. The cells of the parasite are as large as, if not larger than, the cells of the host, and the penetration of these large cells causes a marked disturbance in the cell arrangement of the host. (4) Reinsch describes the stichidia as lance-shaped, but does not mention anything about a curved tip such as is so characteristic of the species which I have studied. (5) The type-species is described as "colore obscure purpureo" (*loc. cit.*, p. 370), while this species is without color, showing very decidedly white against the red color of the host. (6) Reinsch gives the size of the branches or fronds as 54-70 μ broad, and 578-800 μ long. I find in these specimens the fronds are 83-132 μ broad and 182-365 μ long, showing that they are shorter and broader than the type-species.

From a consideration of all these differences, it must be concluded that the parasite found by Dr. Gardner at San Pedro, California, is a new species of Colacodasya.

Colacodasya verrucaeformis W. A. Setchell et M. E. McFadden sp. nov.

Sordide alba, verrucaeformis, 0.5-1.5 mm. diam., parte centrali solida in corpore *Mychodeae episcopalis* J. Ag. usque ad filamenta centralia per rhizoidibus penetrante; ramis liberis 182-365μ longis et 82-132μ latis, sympodialiter ramelliferis; cellulis pericentralibus 7-8, transversaliter 2-3—plo divisis; stichidiis lateralibus, simplicibus aut 2-3—plo ramosis, apicibus conspicue uncinatis; antheridiis lateralibus, cylindraceis, rectis; cystocarpiis lateralibus urceolatis.

Planta parasitica in *Mychodea episcopali* J. Ag., ad San Pedro crescens in ditione Californiae ubi detexit Dr. N. L. Gardner.

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EXPLANATION OF PLATE 19.

Colacodasya verrucaeformis Setchell and McFadden.

Fig. 1.—Cross-section through the solid portion of the parasite and its host. The shaded portions are the shrunken cell contents of the parasite.

Fig. 2.—Tip of the stem to show the sympodial branching.

Fig. 3.—Cross-section through one of the main branches.

Fig. 4.—Stichidium, seen from the side.

All the drawings were made from the prepared specimens by the writer.

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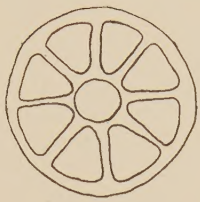

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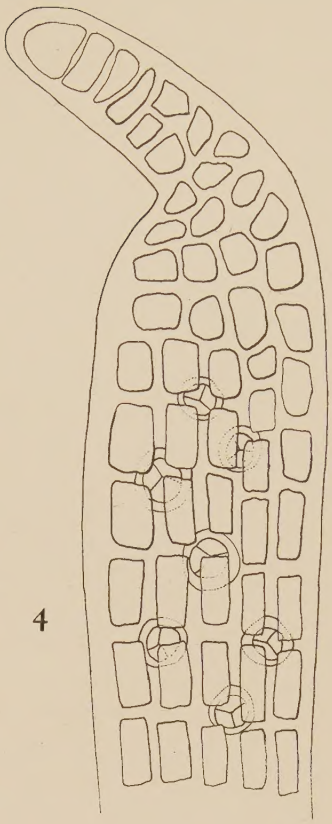

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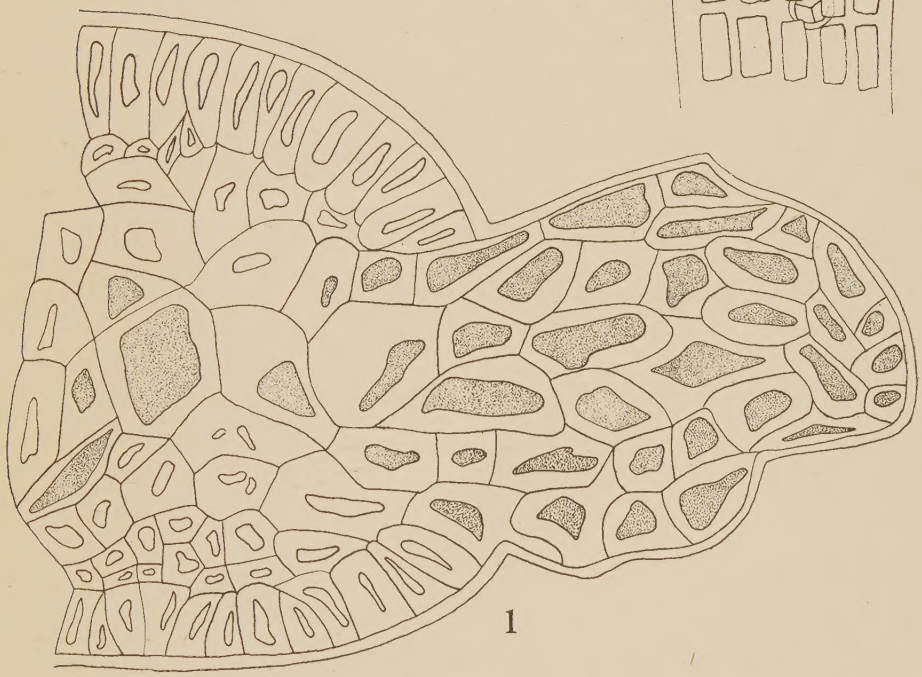

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